REMARKS

I. Single Crystal and Semiconductor Element Claim Changes

The respective scopes of the main independent hexagonal single crystal claim 11 and the main independent semiconductor element claim 21 have been broadened for the following reasons.

As shown by the comparative results in figure 2 (examples 3 and 4) the claimed method produces hexagonal single crystals that have **unexpectedly** less mechanical stress than the comparable prior art methods for growing crystals.

The hexagonal single crystals of the invention with the improved stress values have not been previously made anywhere or at any time. For that reason applicants do not want the patent claim coverage for the hexagonal single crystals of their invention to be limited to hexagonal single crystals made by the method of claim 1. There may be alternative ways to make the hexagonal single crystals with the improved stress values. The same is true of the semiconductor element of the invention.

For that reason the term "made by" has been changed to "obtainable by" in line 1 of claim 11 and line 2 of claim 21.

II. Obviousness Rejection based on Jones, et al (US '586)

Claims 1 to 27 were rejected under 35 U.S.C. 103 (a) as obvious over Jones, et al, (US 5,109,586).

The purpose of the method of the applicants for growing a single crystal according to page 5 of the specification is:

> "to provide a method, with which single crystals may be made simply and in high yield, from which a single crystal substrate with a <0001> orientation may be later obtained economically and in high quality, especially a stress-poor or low-stress high quality single crystal".

It is particularly difficult to grow single crystals with this orientation as explained on page 4, lines 12 to 20, of applicants' specification where it states:

> "Up to now good results regarding crystal quality could not be obtained with the Czochralski method in the c-axis direction because the growing speed must be minimized according to the axial temperature gradient at the phase boundary. Also no economical manufacture of sapphire crystals was possible according to this process generally on account of the limited growing speed. The poor material quality was largely due to the fact that the growth occurred at the atomic smooth [0001] surface. However flaws arise already on this surface with only very little surface energy in this crystal system. Small angle grain boundaries also arise making the substrate material unusable for high quality electronic components."

US '586 does not **claim** a process for growing a single crystal, but instead claims a process for making a crystalline alumina orthodontic bracket. (see claim

1 in column 12 of US '586). There are no steps or details of a crystal growing method in claim 1 of US '586.

US '586 does describe a method for growing a "single crystal" of alumina in columns 4 and 5 and an apparatus shown in fig. 6 for growing crystals in their specification. However it remains to be seen if the quality of their "crystal" is sufficiently high for electronic applications because their "crystalline alumina" may include two or more single crystals separated by a small angle with respect to the grain boundary (see column 4, lines 10 to 14).

US '586 teaches the opposite from the claimed method in applicants' claim 1 in column 5, lines 30 to 54, and thus cannot be used to establish a case of *prima facie* obviousness under 35 U.S.C. 103 (a). US '586 teaches that the longitudinal direction of the growing crystal should be perpendicular to the crystal c axis. For example, in column 5, lines 38 to 44, US '586 states as follows:

> "The minimum amount of strain developed in the growing crystal will occur if the C axis is found in a plane perpendicular to the longitudinal axis L of the rod 30. (See Fig. 7.) This has proven to be the optimum crystal orientation in some cases."

In contrast, step b) of claim 1 requires that the crystal is "drawn upward" or grown "along the crystallographic c axis". That means that the c axis is parallel to the growing direction. This is the exact opposite of the teaching in column 5 of US '586.

The Office Action states that the sole difference between the current claim 1 of the applicants and the disclosures in US '586 is the temperature gradient

limitation, which is also in step b). That is clearly not the case from the above quotations from the applicants' disclosure and US '586. The critical difference between the methods is that the applicants require crystal growth or drawing direction to be parallel to the crystal c axis, while the reference requires that the crystal c axis is perpendicular to the growing direction.

Furthermore since the method described in US '586 for growing crystals is not claimed, the only source of information regarding the details of crystal growing methods is the specific embodiment described in columns 4 and 5 of this reference.

It is well established that a prior art reference that contains teaching of doing the opposite from the claimed invention cannot be used to reject the claimed invention under 35 U.S.C. 103 (a). See MPEP 2145 X. Also the Federal Circuit Court of Appeals has said:

> "In determining whether such a suggestion [of obviousness] can fairly be gleaned from the prior art...It is indeed pertinent that these references teach against the present invention. Evidence that supports, rather than negates, patentability must be fairly considered." ***In re Dow Chemical Co.,*** 837 F.2nd 469,473, 5 U.S.P.Q.2d 1529, 1532 (Fed. Cir. 1988)

Summarizing Jones, et al, US '586 cannot establish a case of *prima facie* obviousness of the method claimed in applicants' claim 1, because the method for growing single crystal material described in column 5 teaches the opposite from step b) of applicants' claim 1.

In addition, US '586 does not recognize the problem that the applicants are trying to solve. The problem is to specifically produce crystals that are grown

in the direction of the c axis, which previously have been previously difficult to grow with good properties, as explained on page 4 and quoted above. How can a reference that does not describe the problem that an inventor is trying to solve suggest the solution to that problem? This is a further indication that US '586 cannot establish a case of *prima facie* obviousness of applicants' claimed method.

In addition, as pointed out in the Office Action the reference does not disclose or suggest other features of the method claimed in applicants' claim 1, such as the temperature gradient limitation in claim 1 step b).

Furthermore the preferred tempering and cooling conditions described in dependent claims 4 and 5 are neither disclosed nor suggested by US '586. These preferred tempering and cooling conditions are important because they contribute to the improved stress-free nature of the crystals grown in the crystal c axis direction.

Example 3 in applicants' specification corresponds to the method claimed in claim 5. Figure 2 of the applicants' disclosure is a graph showing the variation of the stress gradient across a single crystal prepared according to example 3 (curve # 1) and three prior art single crystals (curves 2, 3 and 4). The results clearly show that the single crystal prepared according to example 3 is unexpectedly more stress-free than any of the prior art single crystals. The three prior art single crystals were obtained commercially as explained on page 19 of applicants' specification. Surprisingly even through the single crystal of the invention was grown in the c axis direction and the prior art single crystals were

grown in the m and r direction, the single crystal of the invention had smaller more uniform stress values than those of the prior art.

This objective comparative experimental evidence of unexpectedly improved properties for the crystals grown in the c direction according to applicants' claimed method must be considered during examination (MPEP 716.01 (a)) and would overcome any case of *prima facie* obviousness based on Jones, et al, since Jones, et al, describe a method in which the single crystal is not grown in the c direction like the tested prior art crystals used in the comparative tests of fig. 2. In fact two of the tested prior art single crystals (# 2 and # 3) are grown in the same direction (m-direction) as the crystal according to column 5 of Jones and had considerably higher and more variable stress values.

Furthermore there is a nexus between the differences between the claimed method of claim 1 and the disclosures in US '586 and the comparative results showing unexpected improvements in stress values for the single crystals made by the inventive method. Two prior art crystals were grown in a direction perpendicular to the crystal c axis, while the single crystal of the invention grown according to example 3 of the invention was grown in a direction parallel to the crystal c axis. Also the temperature gradients according to the claimed invention were used for example 3, but the prior art crystals were grown according to commercial methods, because they were obtained commercially.

For the foregoing reasons withdrawal of the rejection of claims 1 to 27 as obvious under 35 U.S.C. 103 (a) over Jones, et al, is respectfully requested.

Should the Examiner require or consider it advisable that the specification, claims and/or drawing be further amended or corrected in formal respects to put this case in condition for final allowance, then it is requested that such amendments or corrections be carried out by Examiner's Amendment and the case passed to issue. Alternatively, should the Examiner feel that a personal discussion might be helpful in advancing the case to allowance, he or she is invited to telephone the undersigned at 1-631-549 4700.

In view of the foregoing, favorable allowance is respectfully solicited.

Respectfully submitted,

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